Infrastructure Engineering and Management

High-Performance Materials and Systems Research Program

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High-Performance Materials and Systems Research Program

Program Objectives:

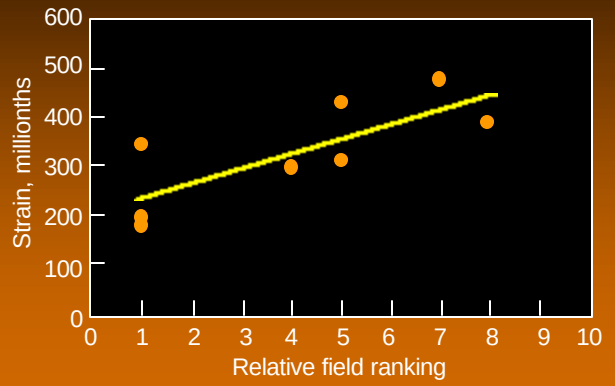
- Develop innovative materials and systems that will extend the service life of existing Corps structures.
- Reduce costs for operation, maintenance, and rehabilitation.
- More durable structures with reductions in project delivery times and construction costs.

Repair Failures

Performance Criteria

28-Day Shrinkage and Field Performance

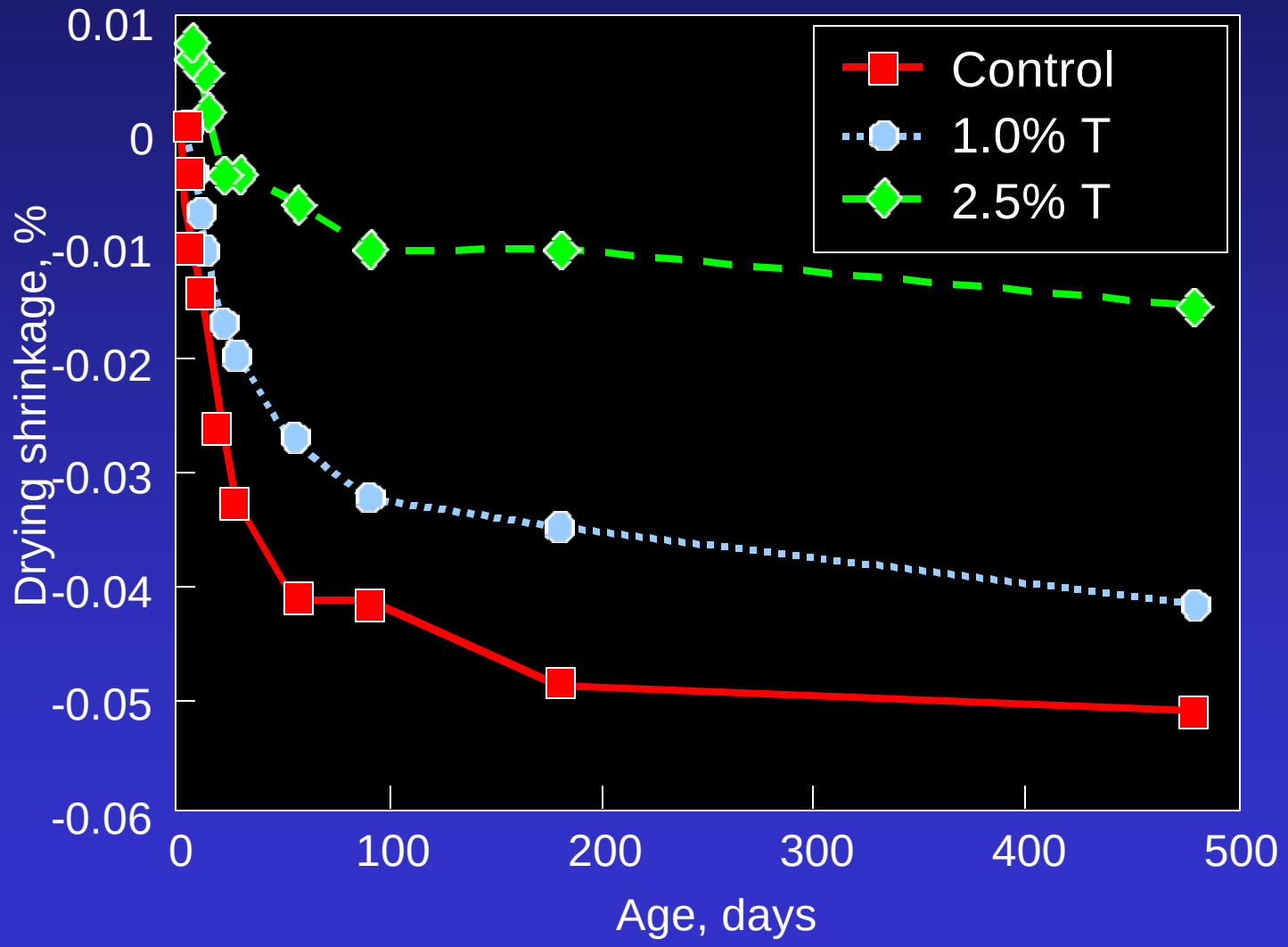
Acceptable Materials



Performance Criteria for Repair Materials

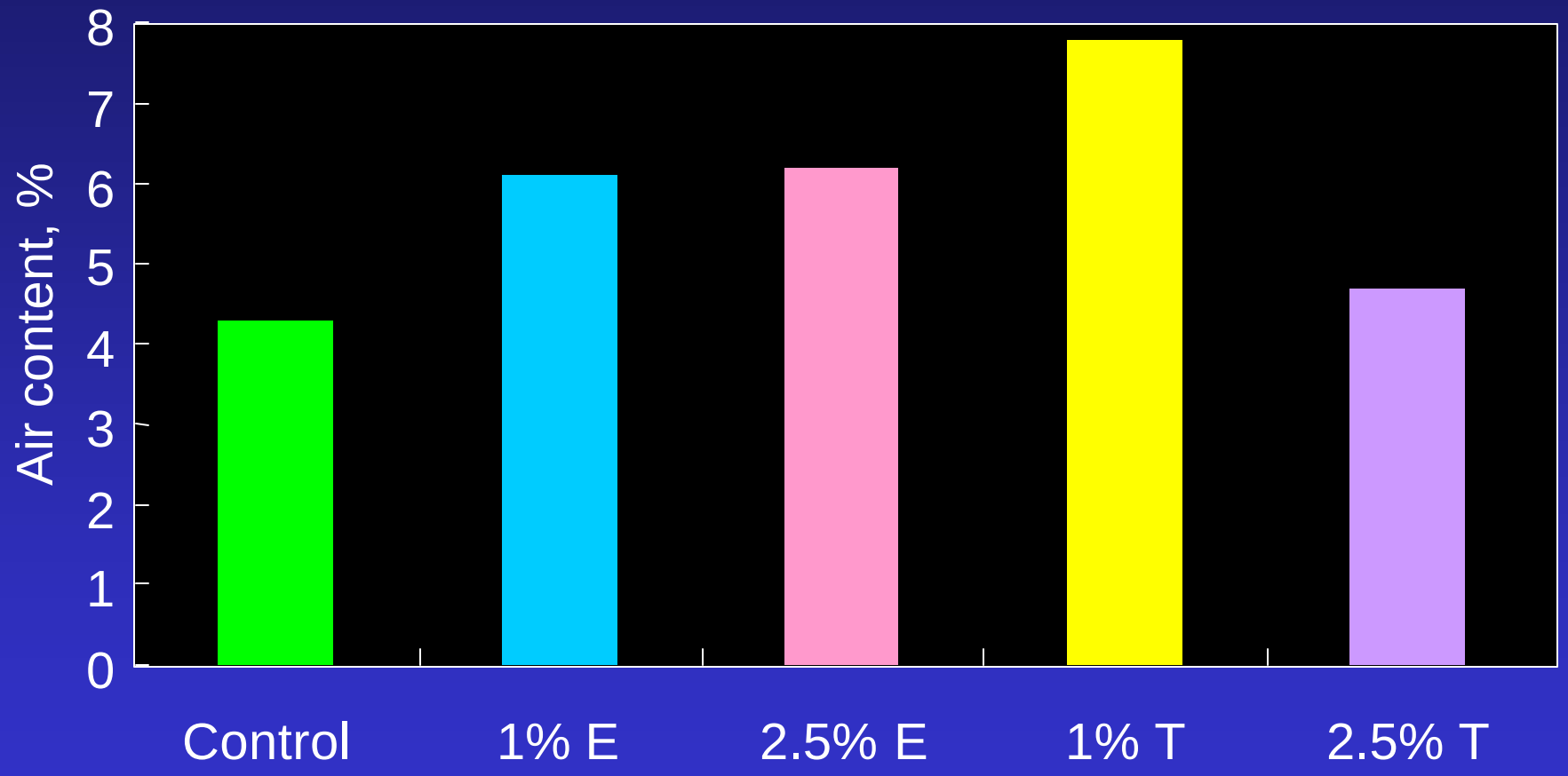
Property	Test Method	Requirement
Tensile strength, min		
28 days	**CRD-C-164**	**400 psi**
Modulus of elasticity, max	**ASTM C 469**	**3.5 x 10^6 psi**
Coefficient of thermal expansion, max	**CRD-C 39**	**7 millionths/deg F**
Drying shrinkage, max	**ASTM C 157 (Modified)**	
28 days		**400 millionths**
1 year		**1,000 millionths**
Restrained shrinkage	**Ring Method**	
Cracks		**None within 14 days**
Implied strain (1yr), max		**1,000 millionths**

Shrinkage-Reducing Admixtures



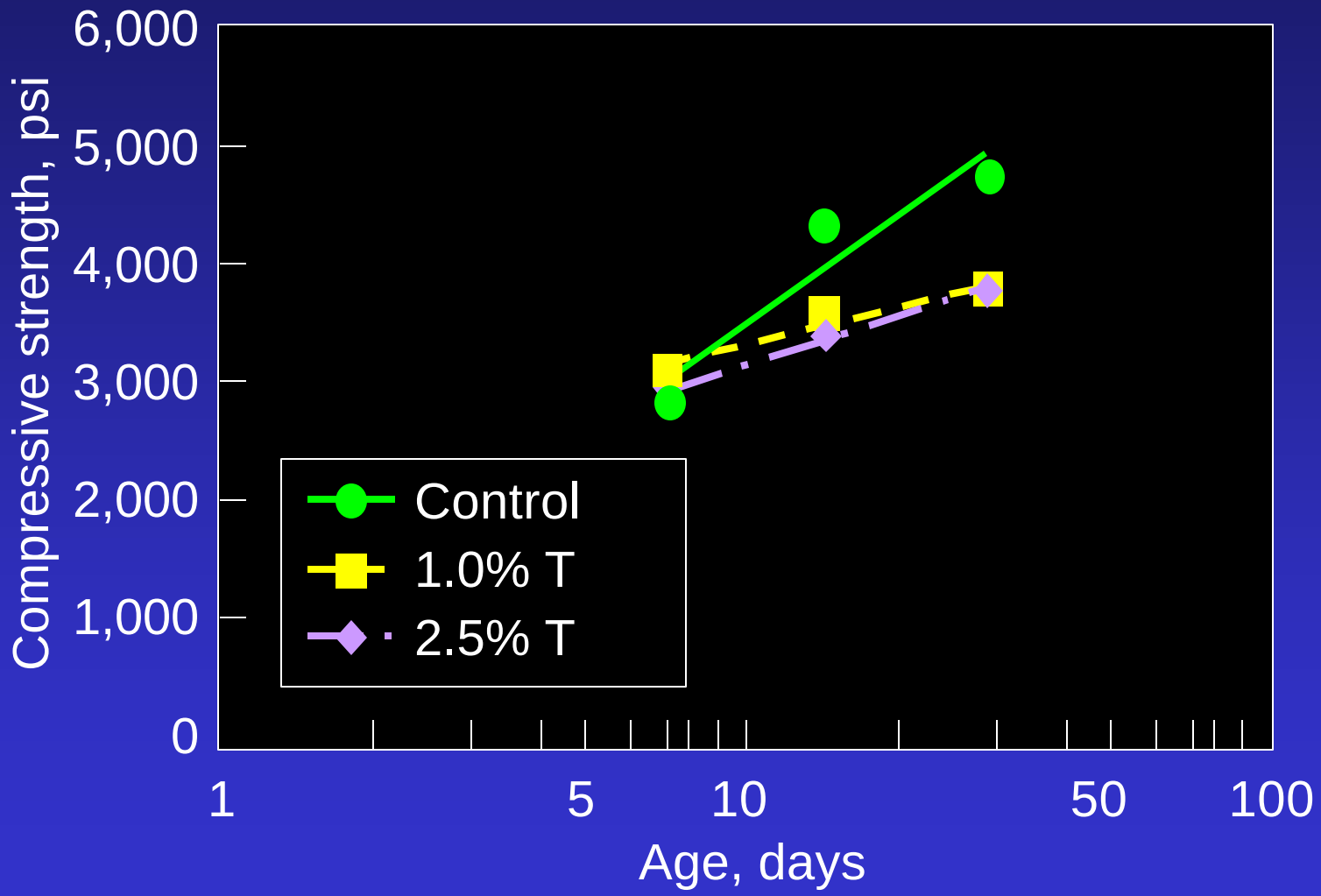
Shrinkage-Reducing Admixtures

Effect on Air Content



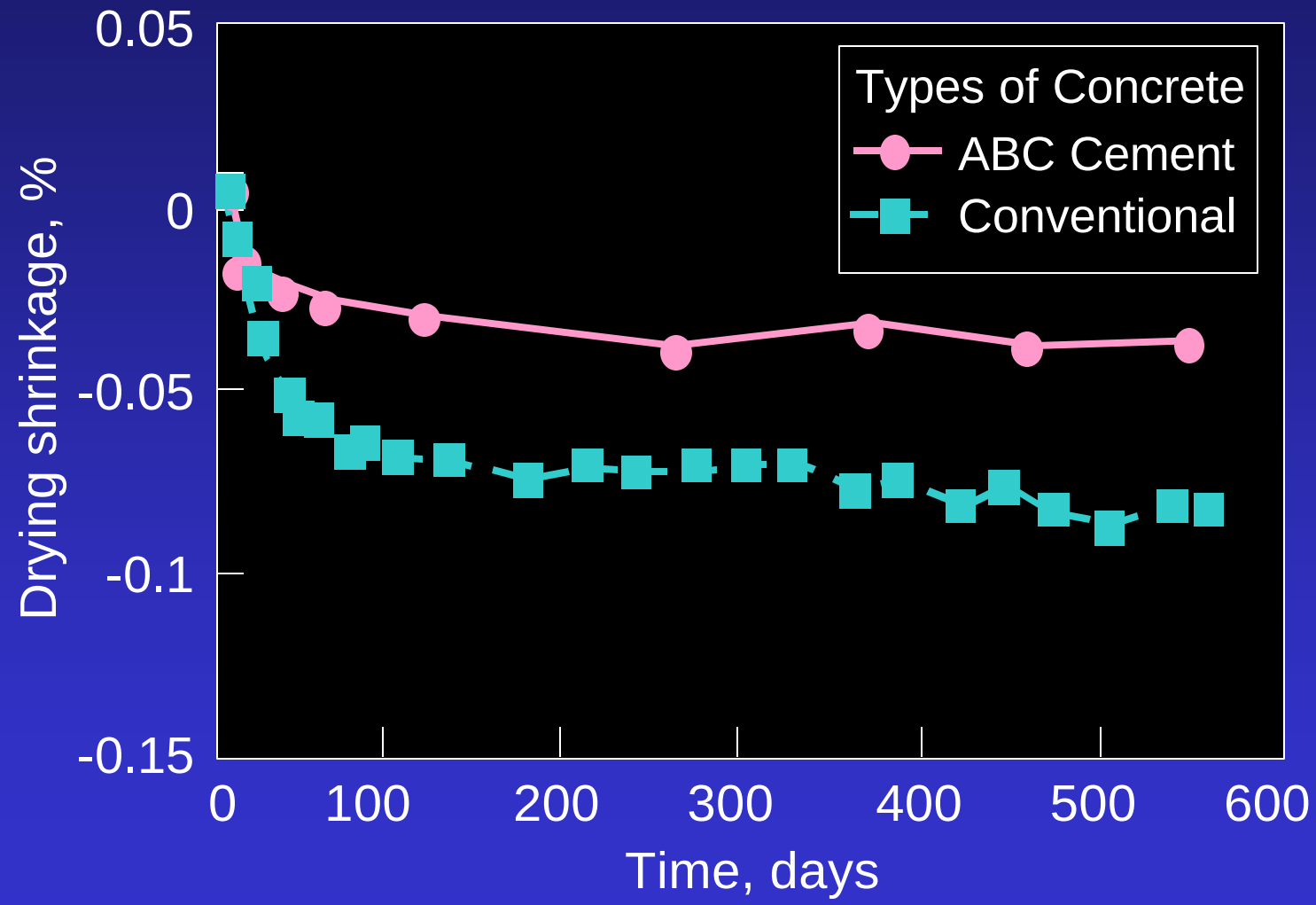
Shrinkage-Reducing Admixtures

Effect on Strength



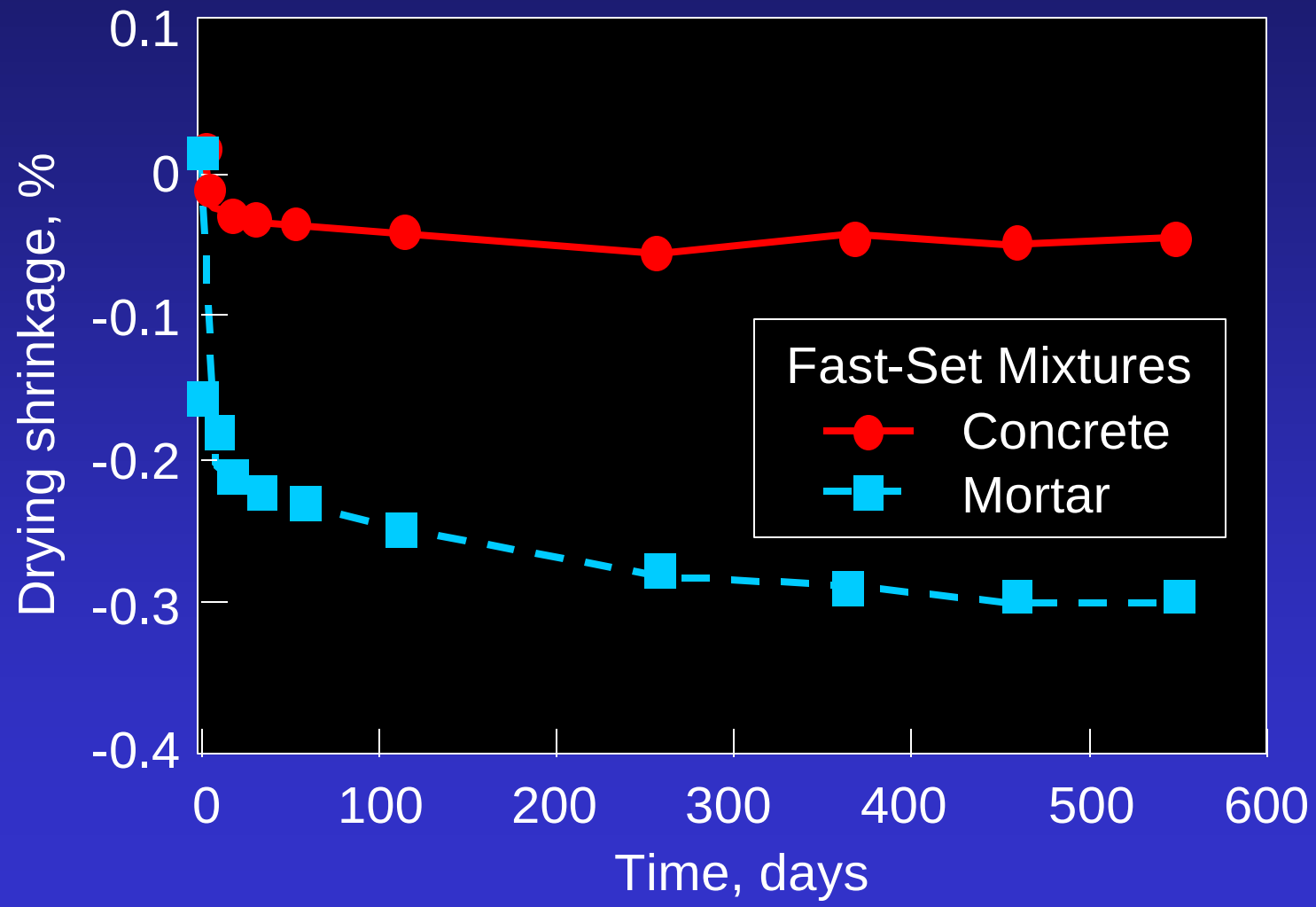
Alkali-Activated Ash Materials

Drying Shrinkage

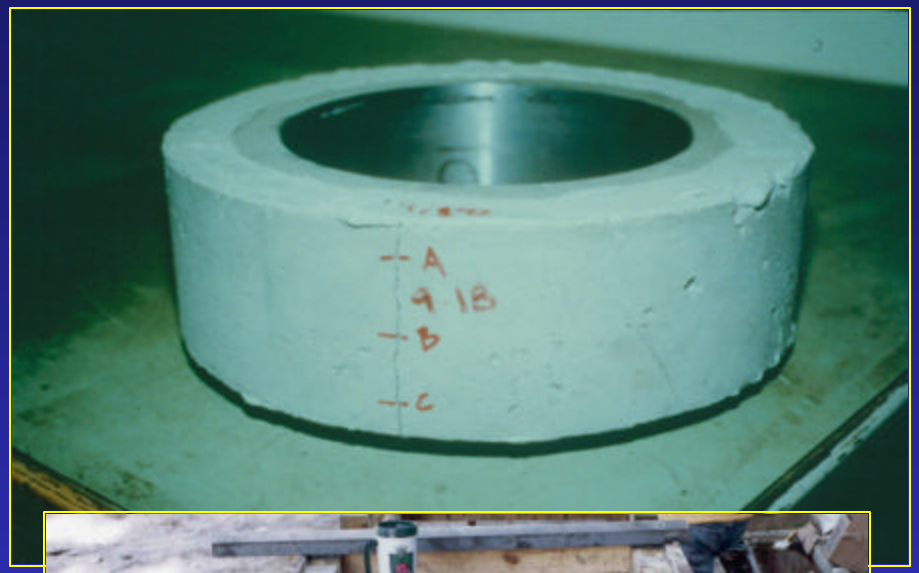


Alkali-Activated Ash Materials

Effect of Aggregate



Restrained Shrinkage Tests



Repair Material Data Sheet Protocol

- Material description
- Composition data
- Physical properties
- Performance properties
- Packaging and storage
- How the material works
- How to use the material

Repair Material Products

- Performance criteria
- Guidance on proportioning materials
- Restrained shrinkage test
- “Green” repair materials
- Standard data sheet protocol
- Material selection and specification guide

Roller-Compacted Concrete

Grout-Enriched RCC

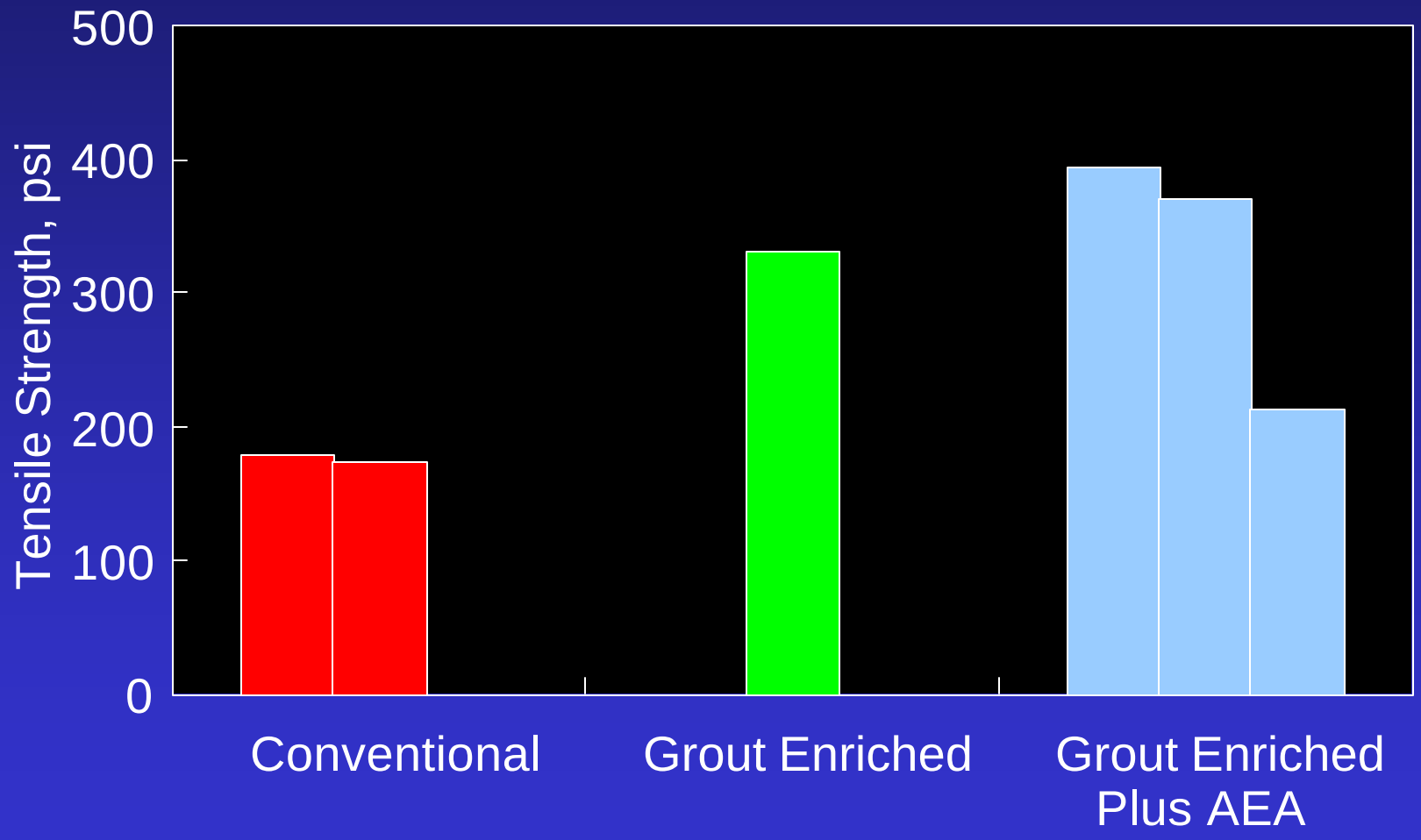
Process

Atlanta Road Dam

GERCC

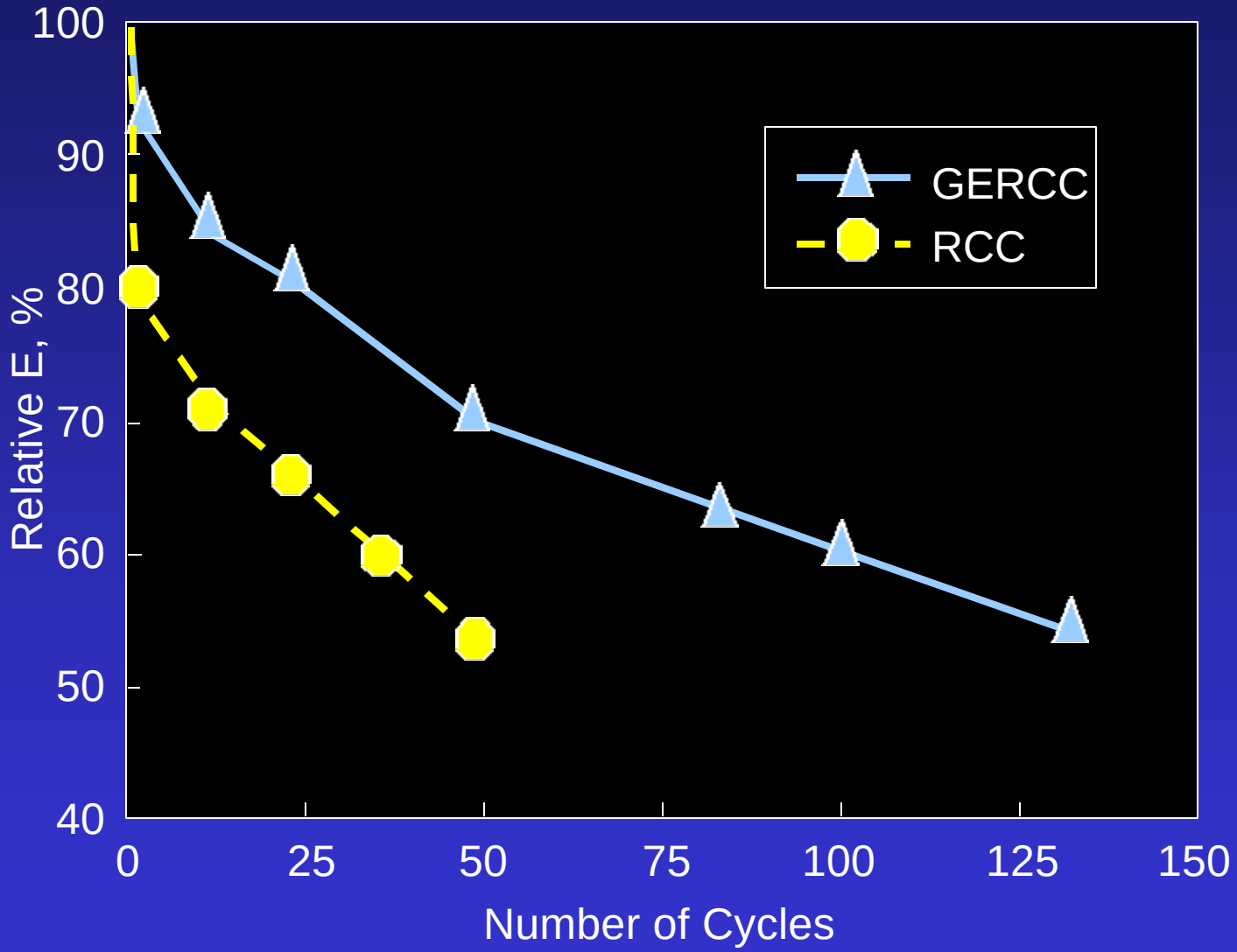
Atlanta Road Dam

RCC Core Tests



Atlanta Road Dam

Results of Freeze-Thaw Tests



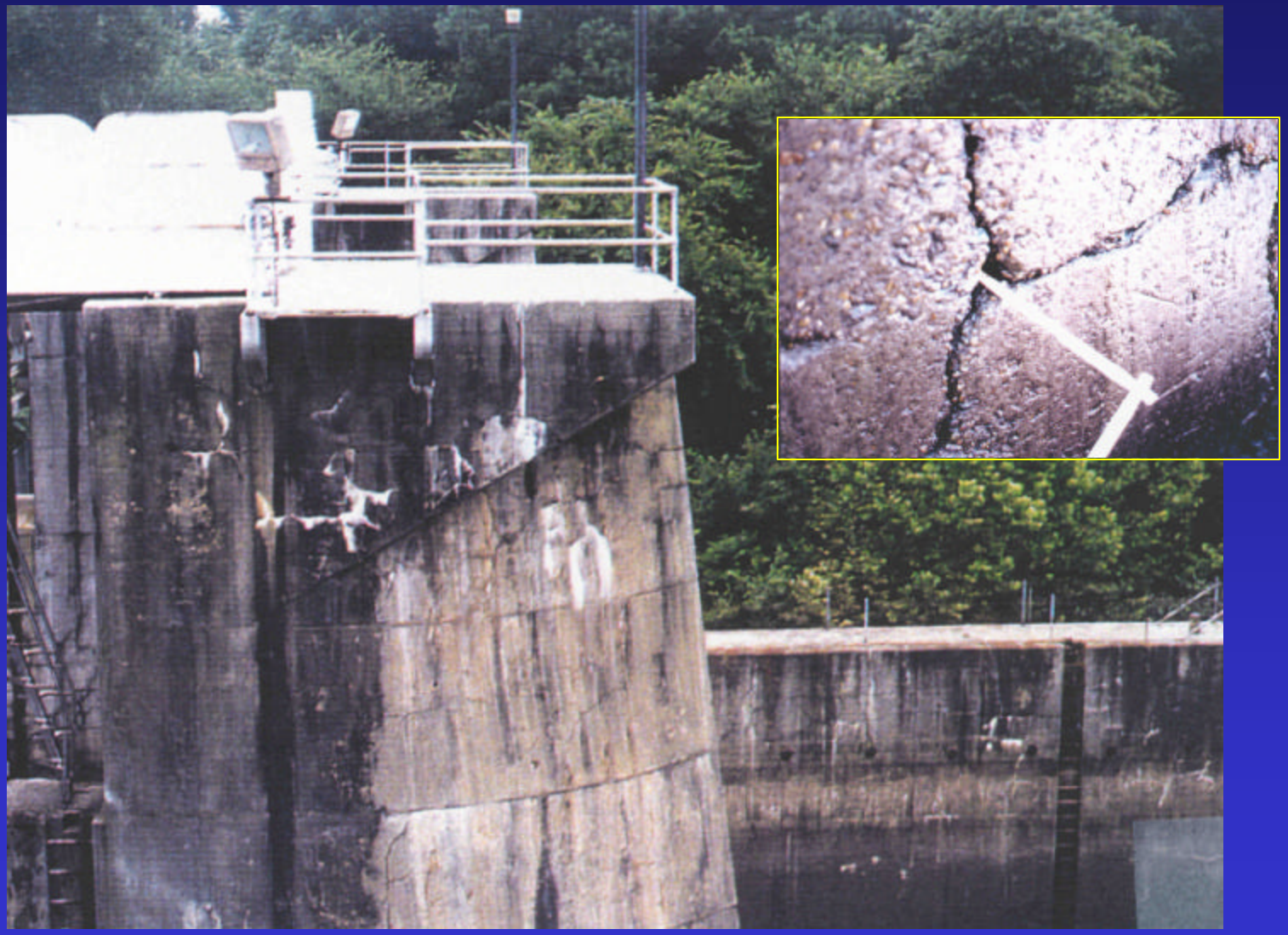
GERCC Benefits

- Durable surface
- Reduced permeability
- Homogenous facing
- High-quality formed finish
- Low cost
- Wider applications

High-Performance Concrete

High-Strength, Abrasion-Resistant Concrete

AAR Mitigation
Lithium-Based Technology



Concerns

Aging Infrastructure

$350-500M Backlog of Required Maintenance

High-Performance Materials and Systems Research Program

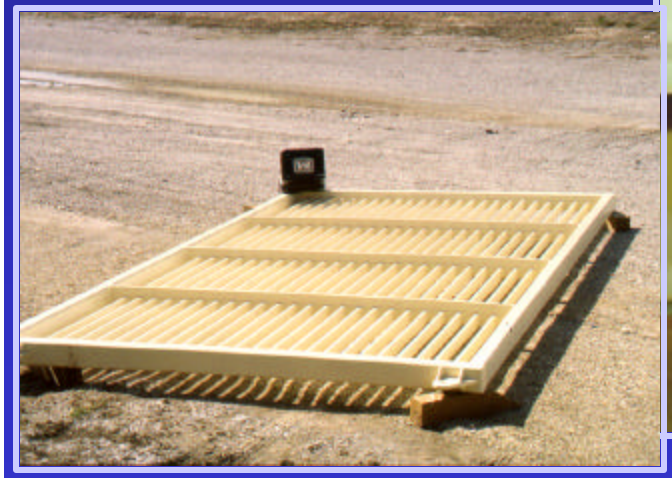
- Paints and Coatings
- Advanced Materials
  - Corrosion Resistant Steels
  - Self Lubricating
- Cathodic Protection

Current Research
High-Performance Paint Systems

- Overcoating Lead-Based Paint

- Metalizing

- New Coating Technologies
- Proprietary Coatings



- Plural Component Urethanes-Polibrid 705 for Intake Screen (Louisville Dist)

- Inhibitive Alkyd Systems

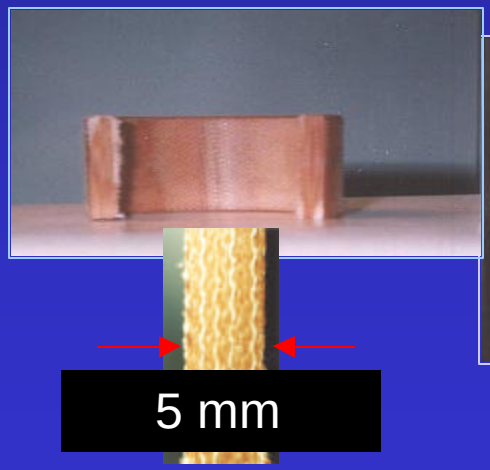
- Environmentally Acceptable Coatings

Current Research
High-Performance Advanced Materials

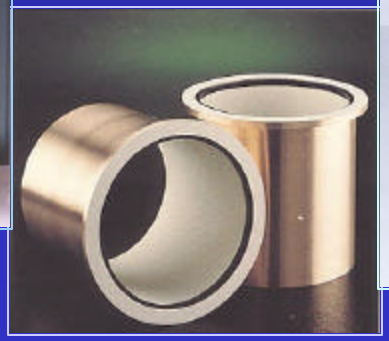
Self lubricating wheels for floating mooring bitts, Barkley Lock & Dam, Nashville District

Freeze fit installation of self-lubricating bushings into tainter gate valve strut arm (McAlpine L&D- Louisville Dist.)

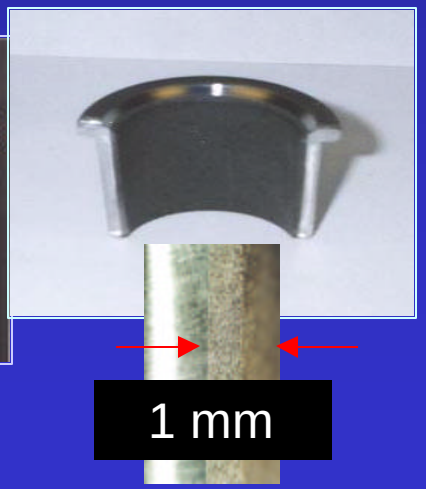
Self lubricating bushings (Kamatics) for chains, Portland Dist.



TENMAT
Ferrofrom T-814



Thordon SXL



Kamatics
Karon-V`

HPM&S (Paints and Lubricants) FY01 Products:

- Guide Specification CEGS-09971revised to allow the use of, and places QC requirements on the use of arc spray metalization equipment.
- Guide Specification CEGS-09965 revised in response to Procurement Reform requirements to allow the use of numerous MPI paint specifications.
- WEB site established showing Corps experience with over 100 proprietary paints or paint systems.
- Guidance for use of environmentally acceptable (EA) lubricants and hydraulic fluids in the corps applications.

High-Performance Paint Systems
BENEFITS

- **Reduced O&M costs for painting & maintenance**
  - Rock Island, Huntington, and other Districts
- **Reduced painting costs in construction**
  - New England District, Walla Walla, and other Districts
- **Regulatory compliance**
  - Rock Island, Seattle, and other Districts
- **Improvement of procurement documents**
- **Improved worker safety**

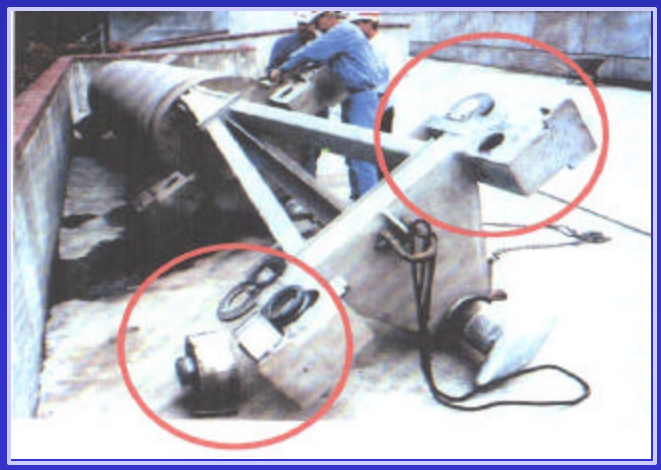
HPM&S (Corrosion and Advanced Materials) FY01 Products:

- Web-posted Advanced Materials Selection Guide for proper selection of materials for lock, dam, and hydroelectric plant components
- Selection guidelines for self-lubricating materials for lock operating machinery components based on performance specifications
  - floating mooring bitts, tainter valves, sector gears, strut arm bushings, and linkages
- Guidance for remote monitoring of cathodic protection (CP) system rectifiers to prevent corrosion of structures

High-Performance Advanced Materials

Benefits

- Proper selection of advanced materials in COE applications will eliminate premature failures
  - Rock Island, Pittsburgh and other Districts
- Minimizing maintenance costs attributed to materials and component replacement costs
  - Huntington, Nashville, other Districts
- Self-lubricating bushings for Lock and Dam Applications
  - Nashville, Louisville, and other Districts



Programmatic Issues: Future Products (FY02, FY03)

- Selection guidelines for lubricating systems for lock gate pintles (FY02).
- Technical guidance for overcoating lead-based paint (FY02).
- WEB site expanded to show additional products (FY02).
- Revised Guide Specification CEGS-09965 to allow the use of industry specification to replace cancelled Fed Spec paints (FY02).
- Selection guidelines for high performance bushing materials for tainter gates (FY03).
- Expert system for advanced materials for lock, dam, and hydroelectric machinery components (FY03).
- Revised Guide Specification CEGS 09971 limiting the amount of recycling allowed when steel abrasives are used (FY03).

Research Needs

Needs not met if HPM&S program ends in FY03:

- Evaluate new coatings, application methods and surface preparation methods
- Provide guidance and field assistance in the proper selection, specification, inspection and performance of coating systems
- Develop an automated system to specify emerging advanced materials
- Develop an automated system to specify coating systems and associated contract requirements
- Expanded use environmentally acceptable (EA) lubricants and hydraulic fluids at Corps projects
- Develop new high performance paint systems that will meet tomorrow's pollution, health, and safety requirements

Concerns:

- HPM&S Program due to end in FY03.
- Work remains to be done.
- Service life of aging infrastructure must be extended.